

18. (Amended) A cell according to Claim 1, wherein the anode compound offers a [relatively low] voltage of 3V or less against pure lithium, while the cathode compound offers a [relatively high] voltage of between 3V and [4,5V] 4.5V against pure lithium.

AS  
19. (Amended) A cell according to Claim 1, wherein the electrolyte is a room temperature electrolyte selected from the group [comprising] consisting of LiClO<sub>4</sub>, LiBF<sub>4</sub>, and LiPF<sub>6</sub> dissolved in an organic [salt] solvent selected from the group [comprising] consisting of propylene carbonate, ethylene carbonate, dimethyl carbonate, dimethoxyethane and [appropriate] mixtures thereof.

20. (Amended) A cell according to Claim 1, wherein the electrolyte is a polymeric electrolyte selected from the group [comprising] consisting of polyethylene oxide (PEO) - LiClO<sub>4</sub>, PEO - LiSO<sub>3</sub>CF<sub>3</sub> and PEO - LiN(CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>.

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### REMARKS

#### **I. Claims in the Case**

Claims 1-20 were under review in the Official Action (the "Action"). Applicants have deleted claim 2, and amended claims 1, 3, 5, 6-8, 10, 11, and 13-20. Therefore, claims 1, and 3-20 are pending in the case.

## **II. Priority of Application**

Applicants file herewith a certified and true copy of South African Patent Application No. 93/6488, as originally filed in the Republic of South Africa on September 2, 1993.

## **III. Drawings**

Applicants will file formal drawings upon allowance of the present application.

## **IV. Rejection of Claims Under 35 U.S.C. § 112, First Paragraph**

The Action first rejects claim under 35 U.S.C. § 112, first paragraph because the disclosure is said to be enabling only for a cathode composed of lithium metal oxide. Applicants traverse the rejection. Pending claim 1 more clearly sets forth what Applicants regard as the invention, and the claim is believed to be adequately supported by the specification. Therefore, it is requested that this rejection be withdrawn.

## **V. Rejection of Claims Under 35 U.S.C. § 112, Second Paragraph**

The Action next rejects claim 1 purportedly for being indefinite and failing to adequately describe the spinel structure. Applicants traverse.

Claim 1 affirmatively recites a "lithium metal oxide;" thus, by definition, A or B must be Li. Thus, the claim pending at the time of the Action is believed to be definite. In any event, as set forth the specification, either A or B must comprise, but not necessarily consist only of, lithium cations, while at least one of A and B must comprise, but not necessarily consist only of, titanium, vanadium, manganese, iron and/or cobalt. Pending claim 1 includes an appropriate

proviso, and further consequential amendments are also included. Support for these amendments may be found in the specification at page 6, lines 8 and 9 of the specification, and in claim 5, which discloses, for example, the compound  $\text{Li}_4\text{Mn}_5\text{O}_{12}$  that has lithium cations in the A and B sites, and manganese cations in the B site together with the lithium cations. In addition, Claim 5 discloses the compound  $\text{LiFe}_5\text{O}_8$  that has iron cations in the A sites, and iron and lithium cations in the B sites. Further support that the A and/or B sites need not consist of a single cation only may be found in Claim 7, which discloses a lithium-iron-titanium oxide compound having lithium and iron cations in the A sites and lithium, iron and titanium cations in the B sites.

Pending claim 1 recites that the electrolyte be ionically conductive. In addition, the phrases "electrically insulative", "lithium containing", "liquid or polymeric" and "ionically conductive" all qualify electrolyte and pending claim 1 reads appropriately.

Claim 3 has been amended to delete the word "type" that hampered a clear reading thereof. It is further respectfully submitted that Claim 3 does indeed further limit the compound of the anode of Claim 1 since, as set out above, Claim 1 covers cases where B is either a single transition metal cation or a mixture of different transition metal cations.

Claims 5 and 6 have been amended to correct the wording of the Markush groups therein.

Claim 7 has been amended to delete the wording that lacked antecedent basis. Furthermore, it is respectfully submitted that this claim is not inconsistent with Claim 1 since, as stated hereinbefore, Claim 1 is not limited to A and B each being a single cation only.

The wording of Claim 8 has been amended to correct the lack of antecedent basis. Furthermore, it is respectfully submitted that the other objection of the Examiner falls away in view of the amendments that have been made to Claim 1.

Claim 10 has been amended so that it emerges clearly that A comprises at least a lithium cation, and is not limited only to a lithium cation. Similarly, B has been amended so that it comprises at least one metal cation. Support for these amendments may be found in the specification at page 7, lines 8 to 23.

It is respectfully submitted that the objections raised in respect of Claims 11 and 12 had been overcome by the amendments made to Claim 10. Additionally, the word "type", which was also objected to in respect of Claim 3, has also been deleted from this claim.

In Claim 13, the Markush group wording has been corrected.

The necessary amendments to overcome the objection to Claim 14 based on lack of antecedent basis have been made. Additionally, it is respectfully submitted that the other objection raised by the Action has been overcome by the amendments made to Claim 10 in which it is set forth that A comprises at least lithium ions but may also comprise other ions, while B comprises at least one metal ion, but may also be a mixture of metal ions.

Claims 15 to 20 have been amended as suggested by the Examiner, thereby overcoming his objections.

Applicants thank the Examiner for his helpful suggestions, and submit that the claims are now in condition for allowance, which action is respectfully requested.

## **VI. Rejection of Claims Under 35 U.S.C. § 103**

### **A. Rejection of Claims as Obvious over Thackeray *et al.***

The Action next rejects claims 1-20 under 35 U.S.C. § 103 as being obvious over Thackeray *et al.*, U.S. Patent No. 4, 507,371. Applicants traverse.

Thackeray is concerned with electrochemical cells having an anode and a cathode coupled together by a solid electrolyte, with each of the anode, cathode and electrolyte comprising a cubic-close-packed framework structure having, as its base structural unit, a unit of the formula  $(B_2)X_4^{n-1}$ , where  $(B)_2X_4$  is the structural unit of an  $A(B_2)X_4$  spinel. This publication also is concerned with an anode of said spinel material, a cathode of said spinel material and a solid electrolyte.

As regards using these components in other combinations with non-spinel compounds, Thackeray deals therewith in a general fashion only. Thus, for example, it mentions in general fashion only that the spinel anodes may be used in cells employing neither of or only one of the cathode and the electrolyte of that invention, i.e. a spinel cathode and a spinel electrode (col 4 lines 54 to 56). It also mentions that "the cathode of the present invention may be used in cells employing neither of or only one of the anode and electrolyte of the present invention", i.e. a spinel anode and a spinel electrolyte (col 4 lines 57 to 59). It also teaches generally that "the electrodes of this invention may be used in an electrochemical cell that employs either a solid electrolyte or a liquid electrolyte or a combination thereof" (col 4 lines 62 to 66).

The only example Applicants can find in Thackeray is col 3 lines 20 to 25, which discloses a cell having a lithium anode (and not a lithium transition metal oxide spinel compound anode as claimed in the instant invention), a spinel ( $LiMn_2O_4$ ) cathode and a liquid electrolyte

comprising 1 molar  $\text{LiBF}_4$  in propylene carbonate. Thus, Thackeray does not teach or suggest an electrochemical cell having as its anode a solid lithium transition metal oxide spinel compound, as a cathode, a lithium metal oxide compound, which may be a spinel, nor of an electrolyte that is a lithium containing liquid or polymer, with the cell operating in "rocking chair" fashion. This "rocking chair" effect occurs when lithium ions are transported between two transition metal oxide electrodes as set out in the specification on, for example, page 2 line 17 running over to page 3, line 6; page 18, lines 6 to 8, and the latter portion of claim 1. The cell of Claim 1 of the present application can thus be considered to be a selection of a particular anode, a particular cathode and a particular electrolyte, to obtain a cell that functions in a particular fashion, i.e. in the "rocking chair" fashion. Such a cell is not at all taught or suggested in Thackeray. *See In re Jones*, 21 U.S.P.Q.2d 1941 (Fed. Cir. 1992)(holding that the PTO's speculation that one skilled in the art would have been motivated to make the modifications of the prior art salts necessary to arrive at the claimed salt was not supported by evidence to support this assertion).

This particular point is highlighted by the fact that Thackeray is not concerned with the advantages arising from the "rocking chair" cell of the present invention. For example, a major advantage arising from the cell claimed in the present instance is that metallic lithium and lithium alloy anodes are not required. At most, lithium is shuttled between the anode and cathode, and metallic lithium or lithium alloy never accumulates at the anode. This inherently provides a very safe cell (specification, page 18 lines 11 to 13).

Finally, while Thackeray teaches that either a liquid or solid electrolyte may be used, in the present invention the electrolyte must be a liquid or polymer, which have the required levels of conductivity for achieving the "rocking chair" effect within practical constraints.

In view of the above, it is respectfully submitted that Thackeray fails to teach or suggest the use of a particular anode, a particular cathode and a particular electrolyte, to obtain a cell that functions in a "rocking chair" fashion, and that the rejection to the claims should be withdrawn.

**B. Rejection of Claims as Obvious over E.P. No. 567,149**

Finally, the Action rejects claims 1-20 as obvious over European Patent No. 567,149. Applicants traverse.

EP 567,149 is said to teach a non-aqueous secondary battery comprising a wide range of anode active materials, a wide range of cathode active materials and a wide range of non-aqueous electrolytes. An apparent crucial feature of the EP 567,149 battery is that the anode active material must be a transition metal oxide of which an inherent crystal structure has been changed by insertion of lithium ions, and is in a condition that the changed crystal structure is not changed during repeated charging and discharging of the battery. A very large number of anode materials are taught, for example, on page 2, page 3, and page 8; however, EP 567149 teaches the use of spinel compounds as anode materials only in the context of, and using examples contained in, U.S. 4,507,371, which has been discussed and distinguished from the present invention under section VI(A) above. Moreover, EP 567149 is silent on the importance

of using only spinel compounds as active anode material, which is the case with the present invention.

EP 567,149 discusses, on pages 3, 7 and 8, a large range of cathode materials, but does not teach or suggest the importance of selecting a particular cathode material by means of which the "rocking chair" effect may be achieved as claimed in Claim 1. Moreover, with regards to the electrolyte, EP 567149 also teaches a large range of electrolytes that may be used such as on, for example, page 10. EP 567,149 however, does not teach the importance of using a liquid or polymer electrolyte, and the resulting advantages of the present invention, as discussed above in respect of Thackeray.

Finally, EP 567,149 does not teach the "rocking chair" effect that is an important feature of the cell of Claim 1. In particular, it does not teach such a rocking chair effect in respect of a cell wherein the cathode also comprises a spinel compound (Claim 9) and/or where the lithium metal oxide compound has a layered structure (Claim 17).

For these reasons, it is respectfully submitted that the subject matter of the claims is not taught or suggested by EP 567,149, and that this rejection should be withdrawn.

## **VII. Conclusion**

Applicants have submitted arguments sufficient to overcome the Action's rejections of the present claims and as such, the present case is in condition for allowance, which action is respectfully requested.



If the Examiner has any questions or comments, or believes that certain amendments of the claims might more readily progress this case towards allowance, a telephone call to the undersigned Applicants' representative is earnestly solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Gary J. Sertich", written in a cursive style.

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